

Interoffice Communication

To Mr. R. W. McPherson, Conoco Chemicals, Houston

From L. D. Jensen, Maintenance Engineering, Ponca City

Date July 27, 1976

Subject VCM Ship Loading - Project No. SD-5-76

As you are aware, I observed the loading of the LPG tanker "Fernbank" at Lake Charles June 14-18. This correspondence will be directed toward the observations made during the operation, possible sources of error contributing to discrepancies between ship and shore figures, and some recommendations to consider for improving the accuracy and repeatability of the measurements.

In your letter of May 18 you suggested a combination of three things you believed may be contributing to discrepancies. The first item was the question of stratification of VCM into isothermal layers in the storage tanks. There is presently no way to determine this in Conoco's onshore spheres. However, the equipment on the "Fernbank" allowed collecting data which may give some indication. Four thermocouples were installed in each of the ship's four tanks spaced at vertical intervals of approximately 1/4 the tank's diameter. All the measurement points could be rapidly read from a single multipoint digital indicator. Forty-two hours after tanks 2 and 3 were loaded, the maximum temperature difference was approximately 0.3°C. for the measurements in the liquid phase of a given tank. The opening and closing temperatures for the spheres from which tanks 2 and 3 were loaded differed by as much as 7°C.

The second item you mentioned was the correlation between the ship's strapping tables and its trim. I studied the strapping tables and followed the chief mate as he prepared the calculations. The tables had been calculated and printed by computer. Volume in cubic meters was presented as a function of liquid level and the difference between the vessel's draft, fore and aft. The increment in liquid level varied from approximately 10 cm for levels less than 2/3 of total volume to 1 cm for the top 1/3. For a given liquid level, volumes were then presented in plus and minus increments of 3 feet for the difference in the ship's draft. It appeared no corrections for the ship's roll were made. The tables and ship's computations in general were very thorough, but my major concern is that any interpolations were done linearly when in fact the relationships are very nonlinear.

The sample locations for temperature measurements in the storage sphere should be two at the minimum; one in the top for vapor temperature, and one in the bottom for liquid temperature. The existing bimetallic dial thermometers should definitely be replaced with preferably a digital temperature measuring device (multipoint thermocouple or RTD). The question of additional temperature sampling points is a difficult one to answer. and I am not sure we could ever come up with true temperature profile.

Why?

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I am working on this question and will discuss it in detail at a later time, but we may be able to eliminate temperature as a required measurement.

Considerable time was spent with the inspectors from Caleb Brett. I was favorably impressed with their sense of responsibility. However, I feel some of their methods could be improved. The plant has done a fine job in providing the necessary tools, ie, storage tank strapping tables, physical property data, etc. But to go one step further, I suggest a complete and concise document or "handbook" be prepared which includes all this information and step-by-step procedures to be followed. Such a "handbook" would not only serve the plant and inspection company with the information required, but also provide the business area with information to aid in preparing and executing individual contracts. This is not to say that the procedures would include anything revolutionary. But rather, by knowing how we plan to perform the operation before we begin. And in doing it the same way each time, we can hopefully eliminate some random error, and be better prepared to answer questions if and when they arise. API Standard 2545 would be a good starting point.

The agreement between ship and shore figures for this loading was within the required $\pm 0.5\%$. The first cargo was within $+0.078\%$ based on shore figures (shore 8576 pounds greater than ship). For the second cargo the difference was -0.2% based on the shore (shore 19985 pounds less than the ship). Although this is very good agreement for the total cargo (-0.054%), a closer look at the individual parts is warranted since both were loaded in a similar manner. The first cargo (to ship tanks 2 and 3) was loaded from two nearly full storage spheres and the tanks were completely filled. The second cargo (to ship tanks 1 and 4) was, however, loaded from one full and one partially filled sphere. Also, ship tank 4 was only half filled. This points out what I consider may be a source of significant random error. That is, the geometric shape of both the ship and shore storage vessels leads to greater volume error for liquid levels at or near the midpoint of the vessels. In this case the error in the ship figures for tank 4 was compounded by the fact that a linear interpolation in the ship's gauging tables was required. If at all possible, we should then start with full storage tanks and end with them empty.

I agree that the plant sphere gauges are more correct in the long term since the plant does have more control and better knowledge of their operation and maintenance. In fact, during this loading, the gauge in T-411-B was checked against its calibration nozzle with very good agreement. I am not aware, however, that the results of such calibration checks are recorded. To obtain historical data for determining calibration schedules and to maintain a calibration record, this information must be well documented as part of ship-loading records.

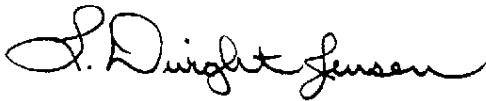
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in VS ~~transfer~~ what showed up in this
case. Not done normally for ship loading or
another reason except when suspect a
gauge problem.*

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Finally, our corrections for VCM vapor returned for recovery to the plant need to be reviewed. For the "Fernbank" cargo all material accumulated in the recovery system was subtracted from the first cargo loaded when in fact the equipment was operated during loading of both cargoes. In addition, until we can verify the amount of material vented from this equipment, it will continue to be a possible source of discrepancy.

After observing the basic mechanics of the shiploading operation from the plant view, I would like to discuss with you the requirements which dictate how individual contracts are executed. I suggest we do this on an informal basis at your convenience prior to the formal meeting you proposed earlier.



L. D. Jensen

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CC:

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